MODEL 158

SIERRA ELECTRONIC CORPORATION

INSTRUCTION MANUAL

H-F WAVE ANALYZER

MODEL 158

Serial Numbers 121-130

Manufactured by

SIERRA ELECTRONIC CORPORATION
3885 Bohannon Drive
Menlo Park, California

WARRANTY

SIERRA ELECTRONIC CORPORATION warrants instruments manufactured by it and bearing Sierra commercial model numbers, except Ion Gauge Tubes, to be free from defective material and factory workmanship and agrees to repair such instruments, which under normal use and service, disclose the defect to be the fault of our manufacturing. Our obligation under this warranty is limited to repairing any such instrument which in our sole opinion upon our examination proves to be so defective, when returned to our factory, transportation prepaid by the purchaser, within one year from the date of original purchase from us.

This warranty does not apply to any of our products which have been repaired, worked upon or altered by persons not authorized by us so as, in our sole judgement, to injure the stability or reliability of such instrument, or which have been subject to misuse, negligence or accident, or the serial number of which has been altered, effaced, or removed. Neither does this warranty apply to any of our products which have been connected, installed, used or adjusted otherwise than in accordance with the instructions furnished by us. Nor does SIERRA ELECTRONIC CORPORATION assume any liability for consequential damages, and in any event our liability shall in no case exceed the original purchase price of the instrument. Accessories, including but not limited to all vacuum tubes, fuses and batteries, not of our manufacture used with this product are not covered by this warranty.

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This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to represent nor assume for us any liability in connection with the sale of our products other than that set forth herein.

SCI-195
July 18, 1956

H.F. WAVE ANALYZER
MODEL S 158
SIERRA ELECTRONIC CORPORATION
SAN CARLOS, CALIFORNIA
DECIBELS
VOLTS
sierra
ATTENUATOR
0
-10
-20
-30
-40
-60
-80
100
3
03
09
1.4
1.6
1.8
5.8
6.0
6.2
MΩ
CAL.
CAL 2
(2 MC)
MEAS.
AUDIO GAIN
OFF
PROBE
(CAL 2)
PHONES
I.F. GAI
(CAL 2)
100X 40 DB
10X 20 DB

SUMMARY OF TECHNICAL SPECIFICATIONS

Power Input	105-125 volts, 95 watts, 50/60 cps
Fuse Protection	3 amp. 3 AG
Frequency Range	0.5 mc to 10 mc
Input Level Range (with 20 db and 40 db capacitive attenuators)	-80 dbm to +42.2 dbm (77.5 microvolts to 100 volts)
Selectivity	
1. 3 db down	±2 kc
2. 30 db down	±12 kc
3. 45 db down	±20 kc
Voltage Accuracy	±2 db (between -10 db and +2 db on meter scale)
Frequency Measuring Accuracy	From ±0.056 mc at low end to ±0.03 mc at high end
Input Impedance	Approx. 1 megohm shunted by less than 6 mmfd
Spurious Response	At least 50 db down
Overall Dimensions	
Width	17"
Height	9"
Depth	13-1/2"
Weight	35 pounds

TECHNICAL SPECIFICATIONS

OPERATING AND MAINTENANCE INSTRUCTIONS

for

MODEL 158 H. F. WAVE ANALYZER

1. GENERAL

The Model 158 H.F. Wave Analyzer is a selective detector for measuring voltages in the frequency range of 0.5 mc to 10 mc and is designed for wave analysis purposes. The input or bridging impedance is high (approximately 1 megohm shunted by less than 6 micro-microfarads) and the instrument is direct reading in volts and dbm when its input probe is bridged across 600-ohm (unbalanced) circuits. Two capacitive divider attachments, an attenuator and an indicating meter provide an overall sensitivity range of -80 dbm to +42.2 dbm (77.5 microvolts to 100 volts at the input probe terminals). A jack is provided on the front panel for monitoring the incoming signal with headphones.

The analyzer is equipped with an injection oscillator, which is in effect a signal generator, for the purpose of calibrating its sensitivity to input voltages.

2. DESCRIPTION

The front view of the wave analyzer is shown in the frontispiece, Fig. 1. A Block Diagram, Fig. 2, is included to help the user understand the functions of the analyzer. The circuit schematic is shown on Fig. 5.

a. Input Circuit

The signal input to the probe input terminal first passes through a cathode follower amplifier contained within the probe, and thence through a length of coaxial cable to the input filter section of the analyzer before arriving at the grid of the first mixer tube. The input filter has a pass band from 0.5 mc to 10 mc. Its purpose is to suppress all signals outside this band. The capacitive divider attachments when used with the probe merely reduce by known amounts the signal arriving at the grid of the cathode follower tube so as to increase the voltage measuring range of the instrument and make possible the measurement of relatively large voltages. The most important function of these capacitive divider attachments is to adjust the magnitude of the signal voltages impressed on the cathode follower grid and first mixer grid to a value which is below that which would generate significant harmonic distortion components or would produce undesirable intermodulation effects. The capacitive divider units provide a 10:1 and a 100:1 voltage reduction ratio respectively (i.e., 20 db

attenuation and 40 db attenuation, respectively), and are employed when input signal levels in the range of 1 to 10 volts and 10 to 100 volts are encountered.

b. Converter Circuits

The MC tuning dial on the front of the analyzer controls the frequency of a variable frequency local oscillator over a range of 22.5 mc to 32 mc. The output of this oscillator combines (heterodynes) with the incoming signal in the first mixer tube to produce an intermediate frequency (I.F.) of 22 mc. After passing through a selective bandpass transformer in the 22 mc I.F. amplifier, the signal combines in the second mixer tube with the output from a 20.89 mc crystal-controlled oscillator to produce a second intermediate frequency of 1110 kc. After passing through a highly selective bandpass transformer in the 1110 kc I.F. amplifier, the signal is applied to the grid of a cathode follower stage, the cathode circuit of which contains the main ATTENUATOR.

The main ATTENUATOR is calibrated in terms of both decibels and full-scale voltage value. Its steps are marked on the attenuator dial in 10 db intervals between 0 db and -60 db and in corresponding voltage ratios. Unlike the input capacitive dividers the main ATTENUATOR operates at only one frequency, 1110 kc, and is accurately calibrated. Signals from the main ATTENUATOR pass through a selective 1110 kc I.F. amplifier circuit and go directly into the crystal detector, the dc output of which operates the DECIBELS meter and the audio output of which is connected via the AUDIO GAIN control to the audio amplifier. The I.F. GAIN (CAL. 2) control, which is provided for adjusting the overall gain of the analyzer, is contained in the cathode circuit of tube (V5), in the 1110 kc I.F. amplifier section.

c. DECIBELS Meter

The output indicating meter has a 0-200 microampere range, but the scale is calibrated in both decibels and volts. The meter calibrations in conjunction with the calibrations on the attenuator dial indicate the voltage levels at the probe input terminal.

CAUTION: When the Model 158 High Frequency Wave Analyzer is received from the factory, the meter pointer may not rest on zero on the voltage scales. This condition is normal and the meter adjustment screw should not be readjusted. The zero adjust screw is set for optimum meter tracking accuracy and is sealed at the factory.

d. Calibrations

The instrument calibrations are based on one milliwatt dissipated in 600 ohms, recognized as 0 dbm. The voltage appearing across the resistor is 0.775 volts, rms. With the ATTENUATOR set at 0 db or 1 the DECIBELS METER will show 0 db or 0.775 volts when 0.775 volts is applied between the input probe terminal and ground.

e. Listening Jack

A PHONES jack is provided on the front panel for the use of a headset, to listen to incoming signals. The headset is energized from an audio amplifier, the

audio level of which is adjustable from the AUDIO GAIN control on the front panel.

f. Tuning Dial

The MC. tuning dial on the front panel has two knobs. The larger knob, centrally located on the dial assembly, is for making coarse tuning adjustments. The smaller knob located at the lower edge of the assembly, is a rim-drive control for making fine tuning adjustments. The tuning dial indicates the input signal frequency directly in megacycles (MC.).

g. Calibration Oscillator

A calibration oscillator, which operates at 2 mc, is included in the analyzer. This oscillator provides a fixed amplitude signal (0.775 volts) which can be applied to the input probe terminal for calibration purposes. When the Calibrate-Measure switch is placed in the CAL.2 position the plate voltage is connected to the calibration oscillator and a 2 mc signal of 0.775 volts rms value becomes available at the PROBE (CAL.2) jack on the front panel. The probe is designed to plug in to this jack for calibration purposes.

The calibration oscillator circuit contains a vacuum tube voltmeter for monitoring the amplitude of oscillations to insure an accurate injection signal amplitude of "0" dbm at 2 mc. The dc output from this vacuum tube voltmeter circuit is shown on the DECIBELS meter when the Calibrate-Measure switch is in the CAL.1 position. This circuit is adjusted for an indication of 0 db when operating properly.

h. Regulated Voltage

The dc voltages used in the analyzer are regulated in the power supply section. The object of this arrangement is to insure relatively constant voltage in the instrument under conditions where the 115 volt mains supply is not constant. An adjustment is provided for setting the B supply voltage at its nominal 225 volt value.

i. Supply Voltage

This wave analyzer is designed to operate from a main supply of 115 volts, 50/60 cycles. It will operate satisfactorily in the range from 105 volts to 125 volts. The power switch is incorporated in the AUDIO GAIN control; turn clockwise for on position.

j. Power Consumption

The wave analyzer total power consumption is approximately 95 watts.

k. Fuse

A fuse for the main supply is located in a holder on the rear of the chassis and is accessible for replacement by unscrewing and withdrawing the black cap marked FUSE. Replacement fuses should be rated at 3 amperes and of the Littelfuse or Bussman 3AG type.

l. Dimensions

The overall dimensions of the analyzer are: 13 1/2" deep (over handles) by 17" wide by 9" high, including rubber feet.

m. Weight

The weight of the complete analyzer is approximately 35 pounds.

3. PERFORMANCE CHARACTERISTICS

a. Sensitivity

The wave analyzer is capable of measuring voltage equivalent to -80 dbm to +42.2 dbm or 77.5 microvolts to 100 volts, rms, using only that portion of the DECIBELS meter scale between -20 db and +2.2 db. Refer to paragraph 2d above for calibration. The way in which sensitivity varies with frequency is shown in a typical sensitivity curve in Fig. 3.

b. Accuracy

Over the frequency range 0.5 to 10 mc, the overall accuracy at any attenuator setting and meter reading (between -10 db and +2 db on the meter scale) is within ±2db. Less accuracy is obtained when using the DECIBELS meter scale below the -10 db mark.

c. Frequency Calibration

The MC tuning dial, which is calibrated in the range from 0.5 to 10 mc indicates the input signal frequency directly in mc and depends for its accuracy upon the factory calibration accuracy and the stability of the 22.5 to 32 mc variable oscillator. Since this oscillator is calibrated and maintained to within 0.25%, the resulting tuning dial accuracy will range from ±0.056 mc at the low frequency end of the dial to ±0.080 mc at the high frequency end.

d. Selectivity

At frequencies 2 kc off resonance, the response is approximately 3 db down. At 5 kc off resonance, the response is at least 10 db down; at 10 kc, at least 26 db down;

and at 20 kc, at least 45 db down. A typical selectivity curve is shown in Fig. 4.

e. Spurious Responses

Spurious responses originating within the wave analyzer are kept to a low magnitude when the instrument is operated in accordance with the operating instructions given herein. There are various types of spurious responses generally encountered in equipments of this type, and they have been classified and defined in various Standards and textbooks related to the radio engineering art. For the convenience of the reader, applicable descriptions of some of these categories are given below:

Harmonic Distortion is generated when the signal amplitude applied to the grid of a vacuum tube is large enough to cause operation over more than the linear range of the grid-plate characteristic.

Direct I.F. Responses can take place when signals applied to the input terminals are at frequencies equal to that of the Intermediate Frequency Amplifiers used within the equipment, when the MC. tuning dial is not adjusted to a setting which would "tune-in" these frequencies.

Image Responses can take place when the frequency of the signal applied to the input terminals is twice the Intermediate Frequency above the MC. tuning dial setting.

Oscillator Beats can produce a spurious meter reading, in the absence of an applied input signal, when the difference between the variable oscillator frequency (or any of its harmonics) and the crystal oscillator frequency (or any of its harmonics) corresponds to the frequency (1110 kc) of the 2nd I.F. Amplifier in the wave analyzer. Although this phenomenon can occur at many different settings of the MC. tuning dial, only a very few are prominent enough to be detectable or to be concerned with in this analyzer.

Representative values of the various type of spurious responses are as follows:

Harmonic Distortion

2nd harmonic:	-55 db to -60 db with respect to applied pure sine wave
3rd harmonic:	-65 db to -75 db with respect to applied pure sine wave
High harmonics:	over -70 db with respect to applied pure sine wave

Direct I.F. Responses

22 mc:	52 to 60 db rejection
1110 kc:	more than 70 db rejection

Image Responses

44 mc above tuning dial setting:	50 db rejection
2220 kc above tuning dial setting:	55 to 70 db rejection

Oscillator Beats

At 8.78 mc tuning dial setting:	-80 dbm
At 6.023 mc tuning dial setting:	better than -80 dbm
At 5.383 mc tuning dial setting:	better than -80 dbm
At 3.29 mc tuning dial setting:	better than -80 dbm
At 2.846 mc tuning dial setting:	better than -80 dbm

f. Input Impedance

The input impedance of the wave analyzer is essentially that of its cathode-follower input probe and is equivalent to approximately a 1 megohm resistance shunted by less than 6 mmf of capacitance at all frequencies. The capacitive divider attachments are designed to the same input capacitance as the probe.

4. OPERATION

a. Gain Standardization Using Calibration Oscillator

The calibration oscillator is adjusted at the factory to deliver a 2 mc signal level of 0.775 volts to the wave analyzer input probe for calibrating purposes when the Calibrate-Measure switch on the front panel is placed in the CAL.2 position. The input probe is plugged into the PROBE (CAL.2) receptacle for this adjustment.

In order to make certain the amplitude from the calibration oscillator is correct, the dc output from the diode vacuum tube voltmeter circuit in the calibration oscillator may be switched to the DECIBELS meter by placing the Calibrate-Measure switch in the CAL.1 position. The circuit is adjusted at the factory to indicate "0" db on the meter when operating properly.

To use the calibration oscillator:

1) Turn the wave analyzer on by rotating the AUDIO GAIN control knob clockwise from its extreme counter-clock-wise position. Allow the instrument to warm up for at least 15 minutes.

2) Plug the input probe (without capacitive divider attachments) into the PROBE (CAL.2) receptacle.

3) Place the Calibrate-Measure switch in the CAL.1 position. The DECIBELS meter should show "0" db. (If not, see maintenance section below for adjustment instructions).

4) Place the Calibrate-Measure switch in the CAL.2 position, set the ATTENUATOR dial at "0" db, and adjust the MC. tuning dial for maximum reading on the DECIBELS meter when tuned to the 2 mc calibration oscillator signal. If the resultant DECIBELS meter reading is not "0" db it should then be set to this value by means of the I.F. GAIN (CAL.2) control knob. The wave analyzer sensitivity is now adjusted to its standard gain value.

5) Place the Calibrate-Measure switch in the MEAS. position and withdraw the input probe from the PROBE (CAL.2) receptacle. The wave analyzer is now ready for making measurements.

b. General Measurement Methods

After carrying out the calibration procedure outlined above, the following measurement procedure should be employed.

1) Touch the tip contact of the input probe to the "high" side of the signal circuit to be measured, after first having attached the ground-lead clip to a suitable ground point in the area of the circuit.

2) With the main ATTENUATOR set at "0" tune the wave analyzer over its entire frequency range of .5 mc to 10 mc and find the input signal frequency component having the largest amplitude. This is usually the fundamental component if a single source of signal energy is acting upon the circuit; but it may be any one of a group of harmonically-unrelated signals if, for example, a multi-channel signal system is involved. If this largest signal component produces a meter deflection in excess of full-scale, attach either the 20 db or 40 db capacitive divider to the probe so that the DECIBELS meter reading occurs somehwere between -15 db and +2 db on its scale. If no signal component is present which is large enough to give the above reading even with no capacitive divider attached, turn the ATTENUATOR down by one 10 db step and repeat the tuning procedure using only

the input probe without dividers. Continue until successful. Note the combined reading of the capacitive divider (if used), ATTENUATOR dial and DECIBELS meter for the largest signal component.

3) With the input probe and capacitive divider combination unchanged from the result arrived at in the above operation, proceed now to tune in the various other signal components whose levels are desired, and, for each one, adjust the ATTENUATOR dial to that position necessary for a meter reading in the -15 to +2 db region of the scale. Note the combined reading of the capacitive divider, ATTENUATOR dial and the DECIBELS meter for each of these components.

4) The db differences between each of the various combined readings obtained in step 3 and the combined reading obtained in step 2 (for the largest amplitude component) then represent the relationships of the lower-amplitude components to the largest amplitude component.

As an illustrative example, assume the wave analyzer is being used to measure the harmonic content of a 2 mc signal source feeding a 600-ohm circuit. The wave analyzer is first standardized for gain as indicated in section 4a above. Its probe is then connected across the 600-ohm load and the 2 mc input signal is tuned in, and, with the main ATTENUATOR dial left at its "0" setting the appropriate capacitive divider attachment (if needed) is selected as required to give a reading between -15 and +2 db on the DECIBELS meter. Suppose this meter reading is "-2" db, when the 20 db capacitive divider (10:1 voltage reduction ratio) is attached. This indicates that the fundamental component of the signal source output has a level of 0 + 20 - 2 = + 18 dbm. Without changing the 20 db capacitive divider, rotate the frequency dial of the wave analyzer to tune in the second harmonic (4 mc) of the signal source under test, adjusting the setting of the ATTENUATOR dial to give a suitable DECIBELS meter reading. Suppose this meter reading is "-7" db, when the ATTENUATOR dial is set at -30. From this, the second harmonic output level of the signal generator is -30 +20 -7 = -17 dbm, which is -35 db with respect to the fundamental. Other harmonic components may be measured in the same manner.

Obviously the voltage levels corresponding to the above mentioned dbm values can be read directly and used to arrive at the equivalent voltage ratio values of the various signal components if the user so desires.

c. Gain Standardization Using External Source

If it is desired to use an external source for gain standardization, the I.F. GAIN control on the front panel of the wave analyzer should be adjusted to produce "0" db reading on the DECIBELS meter with the ATTENUATOR dial set at "0", the MC. tuning dial tuned to the incoming signal and with a signal amplitude of 0.775 volts rms applied to the input probe tip contact. With this adjustment the wave analyzer is set at its standard gain point, i.e., at normal sensitivity. For general sensitivity checks, the frequency used should be approximately 2 mc. However, for maximum accuracy this adjustment should be made with the calibrating source frequency in the region of the frequencies under measurement. Always make certain that the tuning dial is set for maximum response to the input frequency.

d. Tuning Dial

The MC. tuning dial on the front panels reads directly in megacycles over the signal frequency range of 0.5 to 10 mc. The center knob is used to turn the dial when large changes of frequency are desired, whereas the small rim-drive knob below is used for "fine" tuning. The special spiral dial scale has an effective length of 33 inches and the pointed shutter sliding vertically in the dial window indicates which section of the scale is to be read.

Measurements below 0.4 mc should not be attempted because an error is introduced in the reading when the frequency of the 22.5 to 32 mc variable heterodyne oscillator approaches that of the 22 mc I.F. circuit. This error is evident by the large DECIBELS meter deflection in the region of "zero" on the MC. tuning dial.

e. Calibration Oscillator Harmonics

The calibrating voltage is selected from a portion of 2 mc Calibration Oscillator circuit which is rich in harmonics in order to produce usable DECIBELS meter deflections when the MC. tuning dial is adjusted to the harmonics of 2 mc i.e., to the 4 mc, 6 mc, 8 mc, and 10 mc settings. This feature is provided for a quick check of the MC. tuning dial frequency calibration.

CAUTION Use only the 2 mc tuning dial setting for gain standardization purposes when using the Calibration Oscillator as a source of known amplitude signal, since the harmonic voltage amplitudes differ from the amplitude of the 2 mc fundamental.

f. Use of Head-Phones

A head-set may be used for listening to the incoming signals, by plugging into the PHONES jack below the tuning dial. The audio level is adjustable by means

of the control knob labeled AUDIO GAIN. The headset should be of the high-impedance type, preferably above 10,000 ohms, because low impedance phones will not respond as well.

5. MAINTENANCE

a. General

For purposes of reference, schematic diagram E-4596-4 and parts list SA-4585-1 are attached. The Wave Analyzer should require no maintenance during normal use except for occasional change of tubes and the removal of dust and dirt. The change of power supply regulator tubes V11, V12, and V13 may require that the regulator potentiometer "V" be readjusted to obtain the correct B-supply value of 225 volts. Adjustment "V" is located on the top of the chassis near the case of the DECIBELS meter. The change of mixer or I.F. amplifier tubes V2, V3, V5 and V6 may possibly affect the sensitivity of the instrument. Therefore, a recalibration of gain should be made, using either the internal calibration oscillator or an external source of known amplitude voltage preferably around 2 mc (See instruction in section 4c above). If it is found that standard sensitivity is not attainable within the nominal ±7 db range of adjustment afforded by the I.F. GAIN (CAL. 2) control, the wave analyzer circuits should be realigned and/or re-adjusted as later described.

b. Calibration Oscillator

If the calibration oscillator tube V7 is changed, the following adjustment procedure should be followed, after allowing at least a 20 minute warm-up period:

1) With Calibrate-Measure switch in CAL. 1 position, adjust potentiometer shaft "W" (on top of chassis near front) with screwdriver to give "0" db reading on DECIBELS meter.

2) Place Calibrate-Measure switch in CAL. 2 position, plug probe into PROBE (CAL. 2) receptacle and adjust frequency of calibration oscillator to 2 mc by using a screwdriver in inductor tuning screw slot at location marked "H" on top middle of chassis. Tuning can be accomplished by direct beating of calibration oscillator with external frequency standard; or by tuning calibration oscillator frequency for maximum deflection of DECIBELS meter when MC. tuning dial is set to 2 mc. The latter 2 mc tuning dial point should, for maximum accuracy, be pre-set against an external frequency standard.

3) After frequency of calibration oscillator has been set, the DECIBELS meter should read "0" db (providing first that the wave analyzer sensitivity level has been properly adjusted by means of the I.F. GAIN (CAL.2) control in accordance with the External Calibration instructions given in section 4c above). If pointer on DECIBELS meter is not at "0" db, the correct calibration level can be set by adjusting potentiometer shaft "P" (at top front of chassis) with a screwdriver. Interaction between adjustment "H", "P" and "W" may require that the above procedure be repeated several times.

c. Variable Frequency Oscillator

In case it is necessary to change tube V8 (mounted in a horizontal position above the chassis, on the oscillator shield box) in the variable oscillator circuit (to which tuning dial is connected) it may also be necessary to readjust some of the circuit constants so that the MC. tuning dial calibration accuracy is preserved. The adjustments are accomplished as follows:

1) Adjust the frequency of the calibration oscillator to exactly 2 mc in accordance with Para. 5b 2 above. (The Calibrate-Measure switch is in the CAL. 2 position for this condition).

2) Set the MC. tuning dial at 10 mc, plug the input probe into the PROBE (CAL. 2) receptacle, and set the ATTENUATOR dial at "-20" and adjust the variable oscillator trimmer capacitor "X" with a screwdriver for maximum response (to calibration oscillator 5th harmonic) on the DECIBELS meter. The trimmer adjustment "X" is accessible through a hole located on the side of the shield box adjacent to the oscillator tube V8.

3) Set the MC. tuning dial at 2 mc, and the ATTENUATOR dial at 0 db, and adjust the variable oscillator inductor screw "0" (around the corner from the trimmer capacitor "X") for maximum response (to the 2 mc fundamental of the calibration oscillator) on the DECIBELS meter.

4) Since there is a slight amount of interaction between the settings of "X" and "0", steps 5c2 and 5c3 should be repeated three or four times to arrive at the proper final settings for these adjustments.

5) As a final check tune to the 4 mc, 6 mc, and 8 mc harmonics of the calibration oscillator to verify that the frequency calibration of the tuning dial is within the specified accuracy limits over the entire range.

d. Alignment Procedure

In the event it is found necessary to electrically realign the wave analyzer, as mentioned in 5a, the following procedure is recommended:

1) From a suitable low-impedance signal generator apply 2400 microvolts rms at 1110 kc between grid No. 1 (Pin 1) of vacuum tube V5 and the chassis and tune I.F. coils L12 and L11 for maximum response on the DECIBELS meter. The locking nuts on the core screws of the above coils (and of L10 and L9 below) should be loosened slightly just prior to this tuning adjustment and then re-tightened after the adjustment is completed, being careful not to disturb the settings of the adjustment screws in the tightening process. The I.F. GAIN (CAL. 2) control should be set at about its center value for the above adjustments, and the Calibrate-Measure switch should be in the MEAS. position.

2) Set ATTENUATOR dial to "0". Apply .11 volts rms at 1110 kc between grid #3 (Pin 7) of V3 and the chassis and tune I.F. coils L10 and L9 for maximum response. Coupling between these coils is provided by capacitor C24, which is adjusted at the factory to a value just below "critical" coupling. Its setting must not be altered.

3) Without disconnecting the signal generator from the above circuit location, change its output frequency to 22 mc (at .11 volts rms) to check the operation of V3 as a mixer stage. For normal operation the DECIBELS Meter should indicate near "0" reading.

4) Connect the signal generator between grid #3 (Pin 7) of V2 and chassis ground, and, with its output set to give .037 volts rms at 22 mc tune the core screw adjustments of I.F. coils L8 and L7 to give maximum response on the

DECIBELS meter. (The ATTENUATOR dial should be set at 0 db for this adjustment).

5) With the signal generator connected as in the above step, rotate the I.F. GAIN (CAL. 2) control over its range of adjustment (which is approximately 14 db) to determine whether a "0" db DECIBELS meter reading can be obtained within the range of I.F. GAIN (CAL.2) control. The setting for "0" db should not be too near either end of the I.F. GAIN control range. If it is, adjustment of special coupling capacitor C18 may be made (by bending the plates slightly) to center the range of action of the I.F. GAIN (CAL. 2) control. C18 is located on the under side of the chassis in the partition of the shield box beneath quartz crystal Y1.

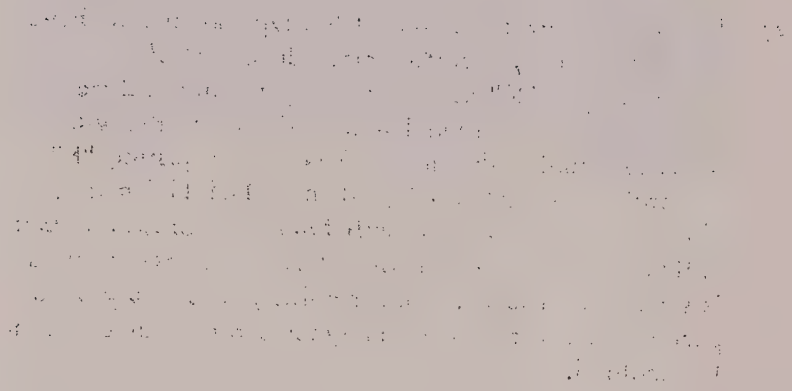
6) Connect the signal generator to the probe contact and adjust its level to give approximately 1 volt rms at 22 mc. Adjust the inductor core screw marked "L" (located on top of the chassis behind variable oscillator shield box) to obtain a minimum reading on the DECIBELS meter, turning the ATTENUATOR dial down to the -40 or -50 db step if necessary.

e. Special Adjustments

Changing the first mixer tube V2 may require readjustment of a special purpose circuit constant other than those covered in the alignment instructions given in section 5d above. This circuit constant is the cathode bais potentiometer marked "K". It is adjusted as follows:

1) Feed a 2 mc pure sine-wave signal (i.e., harmonics at least 70 db below fundamental, by means of a good low-pass filter) into the wave analyzer probe contact at a level of 0.775 volts, rms, tune wave analyzer to 4 mc and adjust potentiomter "K" for a minimum reading on the DECIBELS meter. This adjustment yields the cathode bias value giving minimum 2nd harmonic distortion in the combined dynamic signal characteristic of V1 and V2. It will be necessary to turn the ATTENUATOR dial down to its -50 or -60 db position for the final stage of this adjustment if optimum results are desired. The shaft of potentiometer "K" is located on top of the chassis adjacent tube V2.

2) If a pure sine-wave signal of the type specified above is not available, a compromise adjustment of potentiometer "K" can be made by feeding a 2 mc signal (of no more than 1% distortion) into the wave analyzer, tuning the dial to 2 mc and adjusting "K" to obtain maximum reading of the DECIBELS meter. This maximum indication will tend to be broad, so that optimum adjusting point using this compromise method is somewhat obscure. Nevertheless, reasonably good performance of the wave analyzer can be realized from this method.



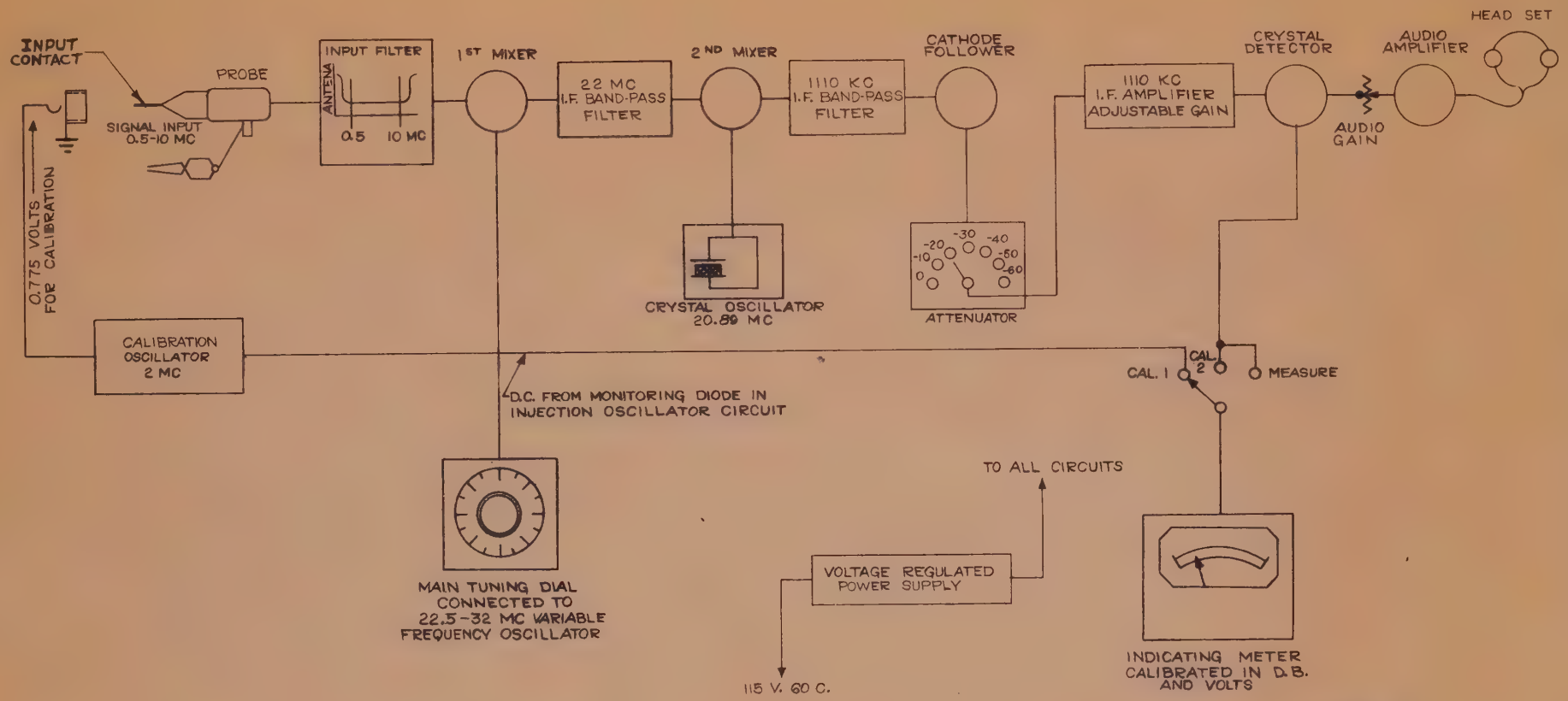


FIG. 2

BLOCK DIAGRAM
H.F. WAVE ANALIZER MODEL 158

SIERRA ELECTRONIC CORPORATION
SAN CARLOS, CALIFORNIA
DATE: 3-28-55 DWG. NO. E-6709-2

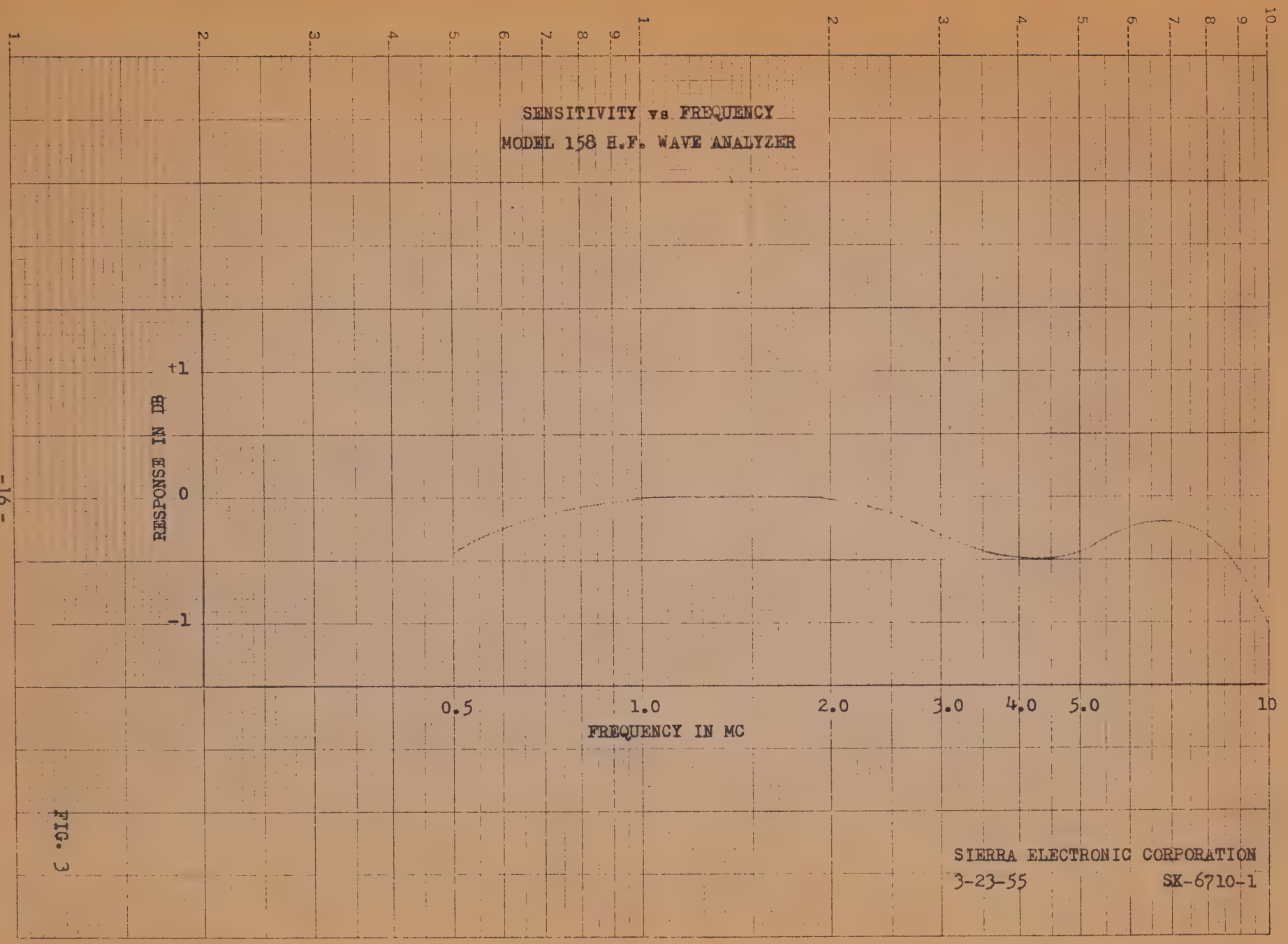

SENSITIVITY vs FREQUENCY
MODEL 158 H.F. WAVE ANALYZER
RESPONSE IN DB
+1
0
-1
0.5
1.0
2.0
3.0
4.0
5.0
10
FREQUENCY IN MC
SIERRA ELECTRONIC CORPORATION
3-23-55
SK-6710-1

FIG. 3

SELECTIVITY CURVE

MODEL 158 H.F. WAVE ANALYZER

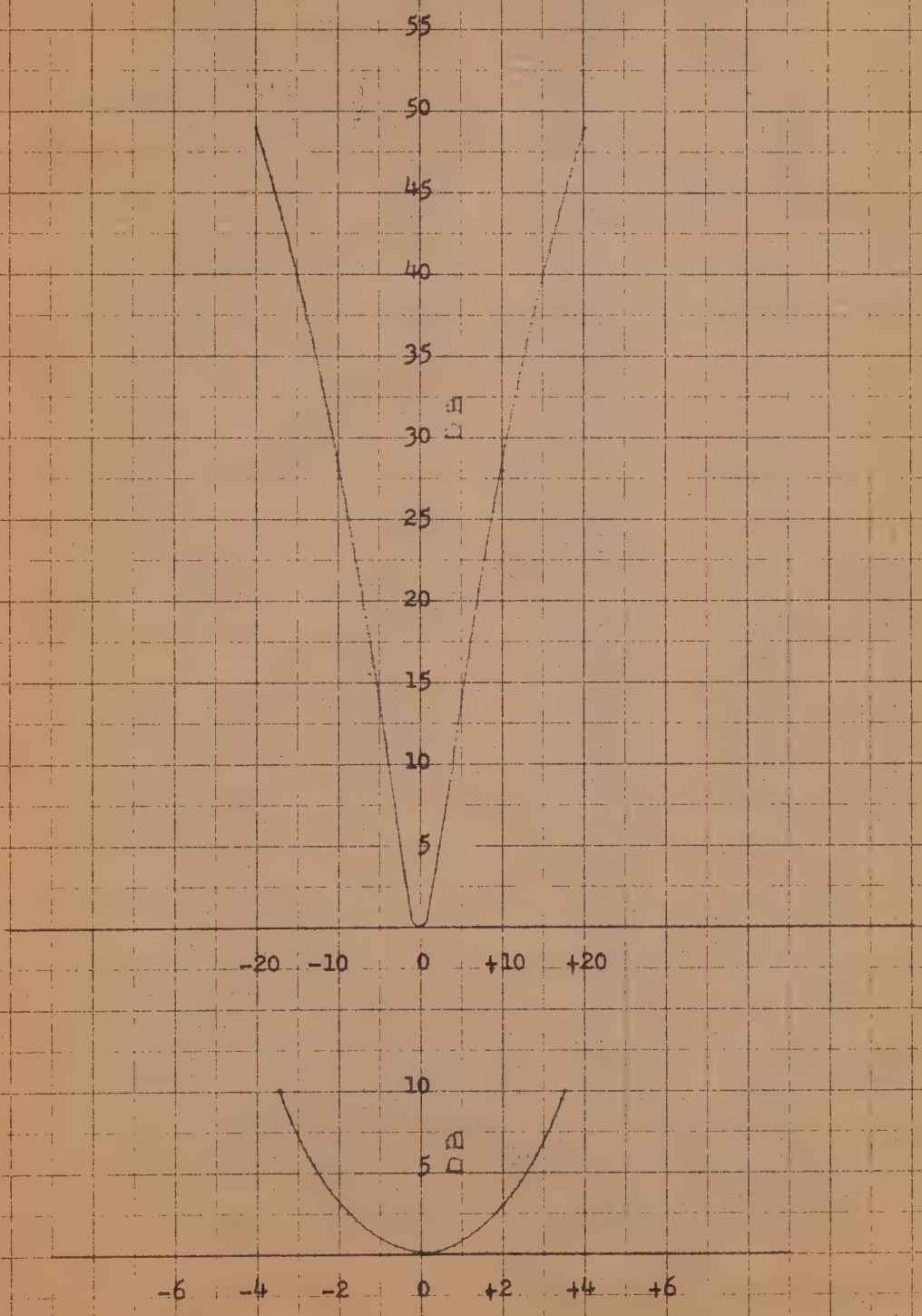


FIG. 4

SIERRA ELECTRONIC CORP.

3-23-55 SK-6712-1

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr. or Supplier	Designation
C1	Silver Mica, 500 mmf ±10%Vdcw	18A501	Erie	Modified 370FE
C2	Ceramic 1.5-12 mmf	32A120	CTC	CST-50
C3	Silver Mica 445 mmf ±2% 500Vdcw	18A4950	Erie	370-CH
C4	Ceramic 1.5 - 12 mmf	32A120	CTC	CST-50
C5	Silver Mica 40 mmf ±2% 500Vdcw	18A400	Erie	370-CH
C6	Ceramic .001 mf 500Vdcw	14X102	Erie	801
C7	Ceramic .02 mf 500Vdcw	14X203	Centralab	DD-203
C8	Silver Mica 117 mmf ±3% 500Vdcw	20H1170	El-Menco	CM15D1170H
C9	Silver Mica 1,930 mmf ±2% 500Vdcw	20G1931	El-Menco	CM20D-1931G
C10	Silver Mica 1,930 mmf ±2% 500Vdcw	20G1931	El-Menco	CM20D-1931G
C11	Silver Mica 234 mmf ±3% 500Vdcw	18A2340	Erie	CM15C100J
C12	Silver Mica 105 mmf ±3% 500Vdcw	18A1050	Erie	370CB
C13	Silver Mica 15 mmf ±5% 500Vdcw	20J150	El-Menco	CM15C150J
C14	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C15	Silver Mica 2 mmf ±5% 500Vdcw	20M020	El-Menco	CM15C020M
C16	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C17	Silver Mica 100 mmf ±5% 500Vdcw	20J101	El-Menco	CM15E101J
C18	Variable Air		Sierra	SU-5987-1-2
C19	Silver Mica 100 mmf ±5% 500Vdcw	20J101	El-Menco	CM15E101J
C20	Silver Mica 10 mmf ±5% 500Vdcw	20J100	El-Menco	CM15C100J
C21	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C22	Silver Mica 510 mmf ±2% 300Vdcw	20G511	El-Menco	CM15E511G
C23	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C24	Ceramic 1.5-7 mmf 500Vdcw	32A070	Erie	TS2A
C25	Silver Mica 510 mmf ±2% 300Vdcw	20G511	El-Menco	CM15E511G
C26	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C27	Ceramic .01 mf +80% -20% 500Vdcw	14X103	Erie	811
C28	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C29	Ceramic .02 mf GMV 500Vdcw	14X203	Centralab	DD-203
C30	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C31	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C32	Silver Mica 510 mmf ±2% 300Vdcw	20G511	El-Menco	CM15E511G
C33	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C34	Ceramic .02 mf GMV 500Vdcw	14X203	Centralab	DD-203
C35	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C36	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C37	Silver Mica 510 mmf ±2% 300Vdcw	20G511	El-Menco	CM15E511G
C38	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C39	Ceramic .01 mf +80% -20% 500Vdcw	14X103	Erie	811
C40	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C41	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C42	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801

Electrical Parts List for Schematic Diagram No. SA-4585-1

MODEL 158 HIGH FREQUENCY WAVE ANALYZER

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr. or Supplier	Designation
C43	Silver Mica 240 mmf ±5% 500Vdcw	20J241	El-Menco	CM15E241J
C44	Silver Mica 470 mmf ±5% 300Vdcw	20J471	El-Menco	CM15E471J
C45	Silver Mica 100 mmf ±5% 500Vdcw	20J101	El-Menco	CM15E101J
C46	Ceramic .001 mf GMC 500Vdcw	14X102	Erie	801
C47	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C48	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C49	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C50	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C51	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C52	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C53	Ceramic 47 mmf ±5% 500Vdcw	14X470	Erie	N750K47±2.5
C54	Variable Air 53 mmf	28A530	Sierra	
C55	Ceramic 3-13 mmf 500Vdcw N300	32X130	Erie	TS2A
C56	Ceramic 20 mmf ±5% 500Vdcw N150	14X200	Erie	301
C57	Silver Mica 47 mmf ±5% 500Vdcw	20J470	El-Menco	CM15E470J
C58	Silver Mica 10 mmf ±5% 500Vdcw	20J100	El-Menco	CM15C100J
C59	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C60	Ceramic .02 mf GMV 500Vdcw	14X203	Centralab	DD-203
C61	Electrolytic 25 mf 25Vdcw	22X256	Sprague	TVA-1205
C62	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C63	Ceramic .02 mf GMV 500Vdcw	14X203	Centralab	DD-203
C64	Paper .01 mf ±20% 600Vdcw	10C103	Sprague	47P6
C65	Paper .01 mf ±20% 600Vdcw	10C103	Sprague	47P6
C66	Electrolytic 20-20 mf 450Vdcw	22A206	Sangamo	PLD4520
C67	Ceramic .01 mf +80% -20% 500Vdcw	14X103	Erie	811
C68	Paper .1 mf ±20% 400Vdcw	10B104	Sangamo	330401
C69	Ceramic .02 mf GMV 500Vdcw	14X203	Centralab	DD-203
C70	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C71	Ceramic .001 mf GMV 500Vdcw	14X102	Erie	801
C72	Silver Mica 150 mmf ±5% 500 v dcw	20J151	El-Menco	CM15E151J
C73	" " " " " "	"	"	"
CR1	Germanium diode 1N34A	105X1N34A	Sylvania	1N34A
C74	Silver Mica 180 mmf. ±5% 500 vdcw	20J181	El-Menco	CM15E181J
C75	Silver Mica " " " "	"	"	"
F1	Fuse, 3 ampere, type 3AG	132X2	Littelfuse	312003
I1	Indicator lamp 6-8 volt 0.15 amperes	138X1	Nat-Union	N47
J1	Jack, Phone, plain	144X3	Switchcraft	11-JAX
L1	Fixed 38.6 microhenries ±3%	90X57	Sierra	SS-4526-1
L2	Fixed 2.34 microhenries ±3%	90X55	Sierra	SS-4605-1
L3	Fixed 19.3 microhenries ±3%	90X56	Sierra	SS-4604-1
L4	Fixed 2.34 microhenries ±3%	90X55	Sierra	SS-4605-1

Electrical Parts List for Schematic Diagram No. SA-4585-1

MODEL 158 HIGH FREQUENCY WAVE ANALYZER

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr. or Supplier	Designation
L5	Fixed 38.6 microhenries ±3%	90X57	Sierra	SS-4526-1
L6	Variable 3.5 microhenries Nom	94X22	Sierra	SS-4779-1
L7	Variable .48 microhenries Nom	94X18	Sierra	SS-4782-1
L8	Variable .48 microhenries Nom	94X18	Sierra	SS-4782-1
L9	Variable 41 microhenries Nom Q200	98X8	Sierra	SS-4673-1
L10	Variable 41 microhenries Nom Q200	98X8	Sierra	SS-4673-1
L11	Variable 41 microhenries Nom Q200	98X8	Sierra	SS-4673-1
L12	Variable 41 microhenries Nom Q200	98X8	Sierra	SS-4673-1
L13	Variable 39.6 microhenries Nom	94X21	Sierra	SS-4525-1
L14	Fixed three pie 1 microhenry	90X58	Millen	34106
L15	Variable .5 microhenry Nom	94X20	Sierra	SS-4783-1
L16	Fixed 1.22 microhenries ±5% 1.65μh	90X54	Sierra	SS-4606-1
L17	Variable 2.3 microhenries Nom.	94X23	Sierra	SS-4780-1
M1	Meter 200 microampere 400 ohms	118X4	Sierra	
P1	Plug and Line cord assembly, 18/3 type SJ 10'6" long with molded male rubber plug, two parallel blades with radial grounding pin	164X2	Cornish Wire	3533
R1	1 meg ±10% 1/2 watt	52X105	AB	Type EB
R2	180 ohms ±5% 1/8 watt	73X1	Electra	DC-1/8
R3	750ohms ±5% 1/2 watt	50X751	AB	Type EB
R4	4.7K ±10% 1 watt	52X472	AB	Type EB
R5	100 ohms ±5% 1/2 watt	50X101	AB	Type EB
R6	Potentiometer 250 ohms ±10% 2 watt	79X32	Sierra	
R7	39 ohms ±10% 1/2 watt	52X390	AB	Type EB
R8	22K ±10% 1/2 watt	52X223	AB	Type EB
R9	15K ±10% 2 watt	60X153	AB	Type HB
R10	2.7K ±10% 1/2 watt	52X272	AB	Type EB
R11	120 ohms ±10% 1/2 watt	52X121	AB	Type EB
R12	22K ±10% 1/2 watt	52X223	AB	Type EB
R13	15K ±10% 2 watt	52X153	AB	Type HB
R14	2.7K ±10% 1/2 watt	52X272	AB	Type EB
R15	1 meg ±10% 1/2 watt	52X105	AB	Type EB
R16	22 ohms ±10% 1/2 watt	52X220	AB	Type EB
R17	1K ±10% 1/2 watt	52X102	AB	Type EB
R18	459 ohms ±1% 1/2 watt	74X30	Electra	DC1/2C
R19	2.96K±1% 1/2 watt	74X31	Electra	DC1/2C
R20	1,081 ohms ±1% 1/2 watt	74X32	Electra	DC1/2C
R21	341.9 ohms ±1% 1/2 watt	74X21	Electra	DC1/2C
R22	108.1 ohms ±1% 1/2 watt	74X19	Electra	DC1/2C

Electrical Parts List for Schematic Diagram No. SA-4585-1

MODEL 158 HIGH FREQUENCY WAVE ANALYZER

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr. or Supplier	Designation
R23	34.19 ohms ±1% 1/2 watt	74X4	Electra	DC1/2C
R24	10.81 ohms ±1% 1/2 watt	74X3	Electra	DC1/2C
R25	5 ohms ±1% 1/2 watt	74X15	Electra	DC1/2C
R26	470K ±10% 1/2 watt	52X474	AB	Type EB
R27	~~220 ohms ±10% 1/2 watt~~	52X~~331~~	AB	Type EB
R28	Potentiometer 2.5K ±10% 2 watt	79X17	Sierra	
R29	270K ±10% 1/2 watt	52X274	AB	Type EB
R30	39K ±10% 1 watt	52X393	AB	Type GB
R31	1.2K ±10% 1/2 watt	52X122	AB	Type EB
R32	1 meg ±10% 1/2 watt	52X105	AB	Type EB
R33	100 ohms ±10% 1/2 watt	52X101	AB	Type EB
R34	39K ±10% 1 watt	56X393	AB	Type GB
R35	1.2K ±10% 1/2 watt	52X122	AB	Type EB
R36	1.5K ±10% 1/2 watt	52X152	AB	Type EB
R37	47K ±5% 1/2 watt	52X473	AB	Type EB
R38	220K ±10% 1/2 watt	52X224	AB	Type EB
R39	Potentiometer 1 meg ±10% 2 watt	79X11	Sierra	
R40	100K ±10% 1/2 watt	52X104	AB	Type EB
R41	Potentiometer 1K ±10% 2 watt	79X43	Sierra	
R42	27K ±10% 1/2 watt	52X273	AB	Type EB
R43	150K ±10% 1/2 watt	52X154	AB	Type EB
R44	Potentiometer 250K ±10% 2 watt	79X9	Sierra	
R45	18K ±10% 1/2 watt	52X183	AB	Type EB
R46	22 ohms ±10% 1/2 watt	52X220	AB	Type EB
R47	47K ±10% 1/2 watt	52X473	AB	Type EB
R48	10 ohms ±10% 1/2 watt	52X100	AB	Type EB
R49	10K ±10% 1/2 watt	52X103	AB	Type EB
R50	180 ohms ±10% 1/2 watt	52X181	AB	Type EB
R51	22K ±10% 1/2 watt	52X223	AB	Type EB
R52	68K ±10% 1/2 watt	52X683	AB	Type EB
R53	1K ±10% 1/2 watt	52X102	AB	Type EB
R54	47K ±10% 1 watt	56X473	AB	Type GB
R55	270 ohms ±10% 1/2 watt	52X271	AB	Type EB
R56	22 ohms ±10% 1/2 watt	52X220	AB	Type EB
R57	2.2K ±10% 1/2 watt	52X222	AB	Type EB
R58	25K ±10% 10 watt	64X253	AB	Type EB
R59	1 meg ±10% 1/2 watt	52X105	AB	Type EB
R60	39 ohms ±10% 1/2 watt	52X390	AB	Type EB
R61	47K ±10% 1/2 watt	52X473	AB	Type EB
R62	Potentiometer 25K ±10% 2 watt	79X34	Sierra	
R63	39K ±10% 1/2 watt	52X392	AB	Type EB
R64	22 ohms ±10% 1/2 watt	52X220	AB	Type EB

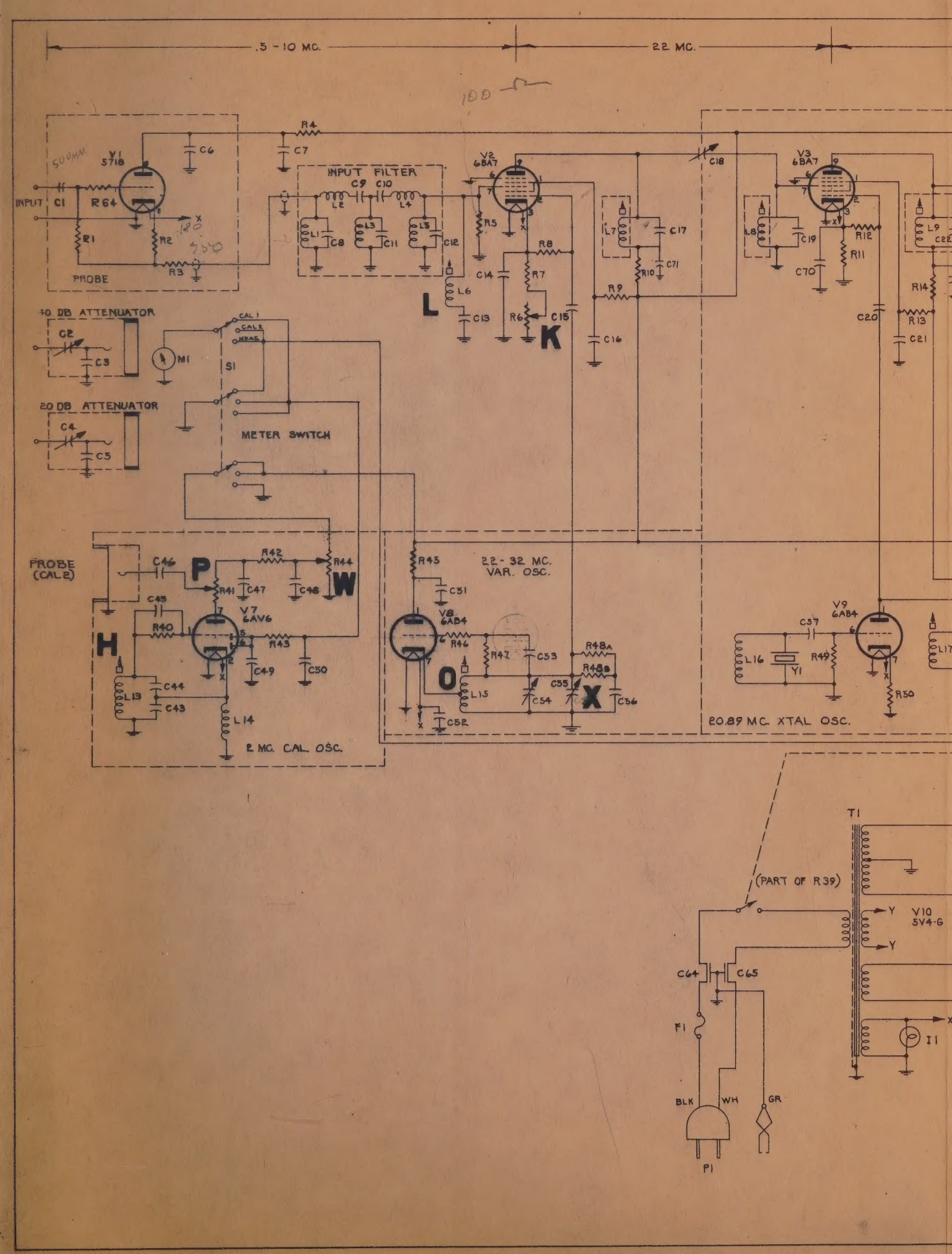
Electrical Parts List for Schematic Diagram No. SA-4585-1

MODEL 158 HIGH FREQUENCY WAVE ANALYZER

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr. or Supplier	Designation
S1	Rotary 3 position 1 section 3 poles	112X4	Sierra	
S2	Rotary 7 position 1 section 1 pole	112X6	Sierra	
T1	Plate and filament	100X3	Sierra	
V1	Tube electron 5718	107X5718		
V2	Tube electron 6BA7	107X6BA7		
V3	Tube electron 6BA7	107X6BA7		
V4	Tube electron 12AT7	107X12AT7		
V5	Tube electron ~~6BH6~~ GCB6	107X~~6BH6~~ GCB6		
V6	Tube electron ~~6BH6~~ GCB6	107X~~6BH6~~ GCB6		
V7	Tube electron 6AV6	107X6AV6		
V8	Tube electron 6AB4	107X6AB4		
V9	Tube electron 6AB4	107X6AB4		
V10	Tube electron 5V4G	107X5V4G		
V11	Tube electron 6Y6G	107X6Y6G		
V12	Tube electron 6SJ7	107X6SJ7		
V13	Tube electron OB2	107XOB2		
XF1	Extractor post	134X1	Littelfuse	342003
XI1	Socket, lamp	142X1	Johnson	147-403
XY1	Socket, crystal	142X7	Millen	33302
Y1	Crystal, quartz 20.89 mc ±.02% 3rd overtone	122X5	Std. Crystal	CR-23/U

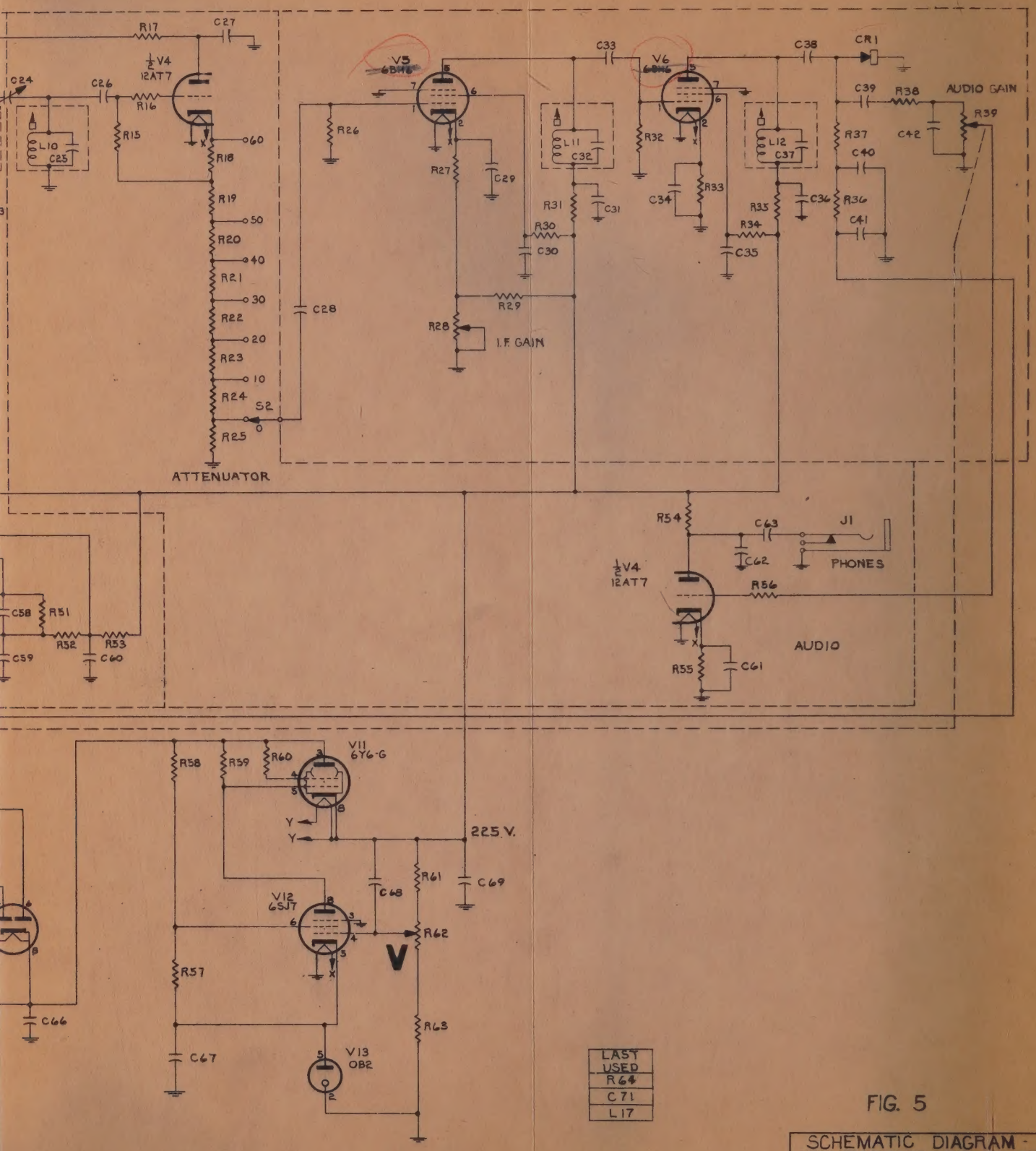
Electrical Parts List for Schematic Diagram No. SA-4585-1

MODEL 158 HIGH FREQUENCY WAVE ANALYZER


.5 - 10 MC.
22 MC.
100
V1 5718
500 OHM
INPUT
C1
R64
C6
R4
C7
R1
R2
R3
PROBE
INPUT FILTER
C9
C10
L2
L4
L1
C8
L3
C11
L5
C12
V2 6BA7
C18
R5
R8
C14
R7
R6
C15
L6
C13
L
K
L7
C17
R10
C71
R9
C16
V3 6BA7
L8
C19
C70
R12
R11
L9
C22
R14
C20
R13
C21
40 DB ATTENUATOR
C2
C3
M1
S1
CAL 1
CAL 2
MEAS
20 DB ATTENUATOR
C4
C5
METER SWITCH
PROBE (CAL 2)
C46
P
R42
R44
W
R41
C47
C48
C45
V7 6AV6
R40
R43
H
C49
C50
C44
C43
L13
L14
2 MC. CAL. OSC.
R45
22 - 32 MC. VAR. OSC.
C51
V8 6AB4
R46
R47
C53
R48A
R48B
C55
C54
C56
O
X
L15
C52
V9 6AB4
C57
L16
R49
Y1
R50
L17
20.89 MC. XTAL OSC.
T1
(PART OF R39)
Y
V10 5V4-G
Y
C64
C65
F1
I1
BLK
WH
GR
P1

REVISION	BY	DATE	ISSUE	CHK
'E-71' ADDED PER CO 266	[illegible]	9/7/54	A	[illegible]
'264' ADDED PER CO 276	[illegible]	[illegible]	B	[illegible]

110 KC.



LAST USED
R64
C71
L17

FIG. 5

SCHEMATIC DIAGRAM -
HIGH FREQUENCY WAVE ANALYZER
MODEL 158

Sierra Electronic Corp.
SAN CARLOS, CALIFORNIA

DRAWN	UPTON	E-4596-4	B
CHK'D	APPD.		
DATE	10-21-54		
SCALE		SHEET NO.	OF